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EXAMINER
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PARSONS, THOMAS H

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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* GREGORY S. HERMAN, PETER MARDILOVICH, and  
JAMES O'NEIL

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Appeal 2008-3354  
Application 10/629,066  
Technology Center 1700

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Decided: July 21, 2008

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Before ROMULO H. DELMENDO, MICHAEL P. COLAIANNI, and  
JEFFREY B. ROBERTSON, *Administrative Patent Judges*.

ROBERTSON, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Appellants appeal under 35 U.S.C. § 134(a) (2002) from the  
Examiner's final rejection of claims 27-32, 34, 36-38, 40, 41, and 43.<sup>1</sup>

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<sup>1</sup> Claims 1-26, 33, 35, 39, 42, and 44 have been cancelled. (Appeal Brief  
filed Aug. 22, 2007, hereinafter "App. Br.," 5).

(Examiner's Answer entered Oct. 30, 2007, hereinafter "Ans."). We have jurisdiction pursuant to 35 U.S.C. § 6(b) (2002).

We AFFIRM.

#### THE INVENTION

Appellants' claimed invention is directed to a fuel cell system comprising a fuel cell stack producing an anode effluent stream, a hydrogen generation unit configured to produce a hydrogen gas stream from the anode effluent stream, and a hydrogen storage unit into which a least a portion of the produced hydrogen gas stream is stored. (Spec. [0012], [0015] and [0020]). The fuel cell system also comprises a structure coupled to the hydrogen storage unit that heats said fuel cell stack by promoting an exothermic reaction using hydrogen from said hydrogen storage unit. (*See* Spec. [0022]). The fuel cell system may include a temperature control unit, such as a heat exchanger. (Spec. [0024]). Appellants also claim a fuel cell system comprising a fuel cell stack, a means for obtaining hydrogen from an anode effluent stream of the fuel cell stack, a means for storing the hydrogen, and a means for heating the fuel cell stack. (Spec. [0015], [0019] and [0022]). Appellants state that the present fuel cell system provides one or more of the following advantages over the prior art: achieves operational temperatures using less energy during start-up; provides additional power during times of high load; and increases overall efficiency of the system. (Spec. [0003]).

Claims 27, 31, 32, 36, and 41, reproduced below, are representative of the subject matter on appeal.

27. A fuel cell system, comprising:  
a fuel cell stack producing an anode effluent stream; and  
  
a hydrogen generation unit configured to produce a hydrogen gas stream from the anode effluent stream of the fuel cell stack;  
  
a hydrogen storage unit into which at least a portion of the produced hydrogen gas stream is stored; and  
  
a structure coupled to said hydrogen storage unit that heats said fuel cell stack by promoting an exothermic reaction using hydrogen from said hydrogen storage unit.

31. The system according to claim 27 further comprising a temperature control unit.

32. The system according to claim 31 wherein the temperature control unit is a heat exchanger.

36. A fuel cell system, comprising:  
a fuel cell stack; and  
  
a means for obtaining hydrogen from an anode effluent stream of the fuel cell stack;  
  
a means for storing said hydrogen; and  
  
a means for heating said fuel cell stack and for speeding up fuel cell startup.

41. The system according to claim 36 wherein the temperature control unit is a heat exchanger.<sup>2</sup>

### THE REJECTIONS

The prior art relied upon by the Examiner in rejecting the claims on appeal is:

Keating	3,539,397	Nov. 10, 1970
LaPierre	6,348,278 B1	Feb. 19, 2002
Edlund	US 2002/0114984 A1	Aug. 22, 2002 (Aug. 13, 2001)

There are four grounds of rejection to be reviewed in this appeal: (i) claims 27-31 and 34 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Edlund; (ii) claim 32 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Edlund further in view of LaPierre; (iii) claims 36-38, 40, and 43 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Edlund in view of Keating; and (iv) claim 41 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Edlund in view of Keating, and further in view of LaPierre. (Ans. 4-7).

### ANTICIPATION UNDER § 102(e)

The Examiner rejected claims 27-31 and 34 under 35 U.S.C. § 102(e) as being anticipated by Edlund. The Examiner found that Edlund discloses a fuel cell system comprising a fuel cell stack producing an anode effluent

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<sup>2</sup> The dependency of claim 41 appears to be improper as claim 36 does not recite a temperature control unit.

stream, a hydrogen generation unit configured to produce a hydrogen gas stream from the anode effluent stream, and a hydrogen storage unit. (Ans. 3-5). Regarding the recitation of “a structure coupled to said hydrogen storage unit,” the Examiner found that Edlund discloses metal hydride beds, which are the same as the structures disclosed by Appellants. (Ans. 5). The Examiner found that the recitation that the structure “heats said fuel cell stack by promoting an exothermic reaction using hydrogen from said hydrogen storage unit,” is a functional limitation that adds no additional structure to the fuel cell system. (Ans. 5). The Examiner also found that because the structural relationship between the hydrogen storage unit and the fuel cell stack are the same as claimed, the fuel cell system of Edlund inherently would provide heat for fuel cell start-up. (Ans. 5). Further, the Examiner found that whether heat is provided to the fuel cell stack for fuel cell start up is dependent upon the manner in which the fuel cell is to be operated. (Ans. 5).

Appellants contend that Edlund does not teach or suggest a structure that heats the fuel cell stack by promoting an exothermic reaction using hydrogen from said hydrogen storage unit. (App. Br. 7 and 9). Appellants argue that the present invention is directed to solid oxide fuel cells, whereas Edlund is directed to proton exchange membrane (PEM) and alkaline fuel cells. (App. Br. 9). Appellants contend that the fuel cells disclosed in Edlund need not be substantially heated for the fuel cell to operate. (App. Br. 9). Appellants additionally argue that although Edlund refers to metal

hydride beds, Edlund does not teach or suggest a metal hydride bed to generate heat for heating the fuel cell stack. (App. Br. 9 and 10).

*The § 102(e) Issue*

We frame the § 102(e) issue as follows: Have Appellants shown that the Examiner erred in finding that all of the claim limitations are anticipated by the prior art?

We answer this question in the negative.

*Findings of Fact Relating to Anticipation*

The record supports the following findings of fact (FF) by a preponderance of the evidence.

1. Appellants' Specification states:

The particular type and design of the fuel cell stack 110 is not critical to the invention. For example, stack 110 may have a dual or single chamber design. Likewise, the anode 140, cathode 150 and electrolyte 145 materials are also not critical to the invention and may be formed from any suitable material, as desired and/or necessitated by a particular end use. (Spec. [0012]).

2. Appellants' Specification states:

For example, suitable electrolyte materials may include, but are not limited to, cubic fluorite structure electrolytes, doped cubic fluorite electrolytes, proton exchange polymer electrolytes, proton-exchange ceramic electrolytes, and mixtures thereof. Further, the electrolyte material may be yttria-stabilized zirconia (YSZ), samarium doped-ceria (SDC,  $\text{Ce}_x\text{Sm}_y\text{O}_{2-\delta}$ ), gadolinium doped-ceria (GDC,  $\text{Ce}_x\text{Gd}_y\text{O}_{2-\delta}$ ),  $\text{La}_a\text{Sr}_b\text{Ga}_c\text{Mg}_d\text{O}_{3-\delta}$  and mixtures thereof. (Spec. [0013]).

3. Appellants' Specification states:

In one embodiment of the invention, the hydrogen storage unit may contain an active material, e.g., a hydrogen oxidation catalyst or other catalytic type material, that promotes exothermic reactions when loaded with hydrogen. For example, metal hydride beds may contain support metal materials that result in an exothermic reaction with an oxygen containing gas. Suitable materials that may be used include, but are not limited to, Pd, Pt, Ru, Rh, Ni and the like, including mixtures thereof. (Spec. [0022]).

4. Edlund states:

Metal hydride beds provide an example of a hydrogen storage device that does not require a hydrogen compressor. Metal hydride beds absorb hydrogen gas at relatively low pressures and temperatures, and then desorb this gas at elevated temperatures and pressures. (p. 3 and 4, [0033]).

5. Edlund states:

Examples of suitable fuel cells include proton exchange membrane (PEM) fuel cells and alkaline fuel cells. (p. 2, [0023]).

6. Edlund states:



The present invention is applicable in any fuel processing system or fuel cell system in which hydrogen gas is produced for delivery to a fuel cell stack or other hydrogen-consuming device. (p. 8, [0066]).

7. Edlund states:

It should also be understood that these components have been schematically illustrated and that the fuel cell system may include additional components that are not specifically illustrated in the figures, such as feed pumps, air delivery systems, heat exchangers, and the like. (P. 1, [0016]).

*Discussion of the § 102(e) Issue*

“A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.” *Verdegaal Bros., Inc. v. Union Oil Co.*, 814 F.2d 628, 631 (Fed. Cir. 1987), *cert. denied*, 484 U.S. 827 (1987). Analysis of whether a claim is patentable over the prior art under 35 U.S.C. § 102 begins with a determination of the scope of the claim. We determine the scope of the claims in patent applications not solely on the basis of the claim language, but upon giving claims their broadest reasonable construction in light of the specification as it would be interpreted by one of ordinary skill in the art. *In re Am. Acad. of Sci. Tech. Ctr.*, 367 F.3d 1359, 1364 (Fed. Cir. 2004). The properly interpreted claim must then be compared with the prior art.

A patent applicant is free to recite features of an apparatus either structurally or functionally. *In re Schreiber*, 128 F.3d 1473, 1478 (Fed. Cir.

1997). Where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that the subject matter shown to be in the prior art does not possess the characteristic relied on. *Id.* The structure of the prior art apparatus must merely be capable of performing the claimed functional recitation. *Schreiber*, 128 F.3d at 1478-79.

The principal dispute between Appellants and the Examiner is whether Edlund discloses “a structure coupled to said hydrogen storage unit that heats said fuel cell stack by promoting an exothermic reaction using hydrogen from said hydrogen storage unit.” We first address the interpretation of this limitation. The Specification does not expressly define what is meant by “a structure coupled to said hydrogen storage unit.” However, the Specification discusses hydrogen storage units and states that the hydrogen storage unit “may contain an active material, *e.g.*, a hydrogen oxidation catalyst or other catalytic type material that promotes exothermic reactions when loaded with hydrogen.” (FF 3). The Specification further states that “metal hydride beds may contain support metal materials that result in an exothermic reaction with an oxygen containing gas.” (FF 3). The Specification then states that “[t]he heat generated as a result of the exothermic reaction may then be used as a heat source.” (FF 3). Thus, the “structure coupled to said hydrogen storage unit” includes a metal hydride bed present in the hydrogen storage unit, which “heats said fuel cell stack by

promoting an exothermic reaction using hydrogen from said hydrogen storage unit” as a result of the metal hydride bed structure.

In accordance with the above interpretation, we find Appellants’ argument that Edlund does not teach or suggest a structure coupled to said hydrogen storage unit as claimed unpersuasive. We agree with the Examiner that the structural relationship between the hydrogen storage unit and the fuel cell stack in Edlund are the same as presently claimed. (Ans. 5) Specifically, Edlund discloses the use of metal hydride beds as a hydrogen storage device. (FF 4). These are the same hydrogen storage devices disclosed by Appellants as containing structures that heat fuel cell stack by exothermic reactions. (FF 3). Thus, as found by the Examiner, the metal hydride beds of Edlund would inherently provide heat for fuel cell start-up depending on the manner in which the fuel cell is operated (i.e., Edlund’s structure would be capable of performing the recited heating function). (Ans. 5). Although Appellants argue that Edlund does not teach or suggest a metal hydride bed to generate heat for heating the fuel cell stack, Appellants provide no evidence to rebut the Examiner’s well supported finding of inherency (App. Br. 10) or that Edlund’s identical structure would be incapable of performing the heating function. Appellants bear the burden to show that Edlund’s structure would be incapable of performing the recited heating function. *Schreiber*, 128 F.3d at 1478. Appellants’ mere argument that the fuel cells disclosed by Edlund would not be subject to heating during start-up is insufficient to satisfy their burden.

We also agree with the Examiner that Appellants' argument that Edlund is directed to different types of fuel cells than claim 27 is not commensurate in scope with the claim. (Ans. 10). Claim 27 is not limited to a solid oxide fuel cell. Indeed, Appellants' Specification discloses that the type and design of the fuel cell stack is not critical to the invention and that fuel cells with proton exchange electrolytes may be used, which are similar to the electrolytes disclosed in Edlund. (FF 1, 2, and 5). Additionally, Appellants' argument is not consistent with Edlund's disclosure. As pointed out by the Examiner, Edlund is not limited to proton exchange membrane (PEM) and alkaline fuel cells, but lists these types of fuel cells as examples. (Ans. 10 and 11, FF 5). Further, Edlund discloses that the invention is applicable to any fuel cell system in which hydrogen gas is produced. (FF 6). For these reasons, Appellants' arguments are not persuasive.

#### OBVIOUSNESS UNDER § 103(a)

The Examiner rejected claims 36-38, 40, and 43 under 35 U.S.C. 103(a) as being unpatentable over Edlund in view of Keating.<sup>3</sup> The

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<sup>3</sup> We note that although the Examiner made no specific statements regarding the means-plus-function language in claim 36, Appellants do not contest the apparent application of 35 U.S.C. § 112, 6<sup>th</sup> paragraph to the claim. Nor do Appellants contest whether the structure of the prior art corresponds to the structure or equivalent structures of the claim limitations as set forth in the

Examiner found that Edlund teaches all the limitations of claim 36, except a means for heating the fuel cell stack and for speeding up fuel cell start-up. (Ans. 7 and 8). The Examiner found that Keating discloses a means for heating the fuel cell stack and for speeding up fuel cell startup by incorporating a start-up heater into the fuel cell system. (Ans. 8). The Examiner determined that it would have been obvious to modify the fuel cell stack of Edlund by incorporating the startup heater of Keating into the fuel cell system of Edlund, because a start-up heater would provide improved control over the temperature at which the process in a fuel cell is carried out, thereby improving the overall performance of the fuel cell. (Ans. 8 and 9).

The Examiner rejected claim 32 under 35 U.S.C. § 103(a) as being unpatentable over Edlund as applied to claim 27, and further in view of LaPierre. The Examiner also rejected claim 41 under 35 U.S.C. § 103(a) as being unpatentable over Edlund in view of Keating as applied to claim 36, and further in view of LaPierre. Claims 32 and 41 both recite the limitation that the temperature control unit is a heat exchanger. For claim 32, the Examiner found that Edlund did not teach that the temperature control unit is a heat exchanger, although Edlund does disclose heat exchangers as additional components. (Ans. 6, FF 7). Likewise, for claim 41, the Examiner found that Edlund in view of Keating did not teach that the temperature control unit is a heat exchanger. (Ans. 9).

The Examiner found that La Pierre discloses directing a purified hydrogen stream exiting a hydrogen separating membrane into a heat

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Specification.

exchanger to cool the hydrogen to a temperature compatible with the fuel cell. (Ans. 6 and 9).

The Examiner determined that it would have been obvious to one of ordinary skill in the art to modify the apparatus of Edlund or Edlund in view of Keating by incorporating the heat exchanger of LaPierre, because LaPierre discloses that a heat exchanger cools the hydrogen to a temperature that is compatible with the operation of the fuel cell, thereby improving the overall performance of the fuel cell system. (Ans. 6, 7, 9 and 10).

Appellants contend that the fuel cells disclosed by Edlund need not be substantially heated to operate such that one of ordinary skill in the art would not have found it advantageous or desirable to incorporate a start-up heater. (App. Br. 10). Appellants additionally argue that the Examiner is incorrect in asserting that Edlund's fuel cell would experience an improvement in overall performance if it were modified to include the start-up heater of Keating, which is directed to a different type of fuel cell. (App. Br. 10, Reply Brief filed Dec. 21, 2007, hereinafter "Reply Br.," 1).

Regarding claims 32 and 41, Appellants argue that the cited prior art fails to teach the limitations of these claims for the same reasons that the prior art fails to teach the limitations of the independent claims from which claims 32 and 41 depend. (App. Br. 10 and 11).

*The § 103(a) Issue*

We frame the § 103(a) issue as follows: Have Appellants shown that the Examiner erred in rejecting the appealed claims as being obvious to one of ordinary skill in the art over the cited prior art of record?

We answer this question in the negative.

*Additional Findings of Fact Relating to Obviousness*

The record supports the following findings of fact (FF) by a preponderance of the evidence.

8. Keating states:

The heater **60** is advantageous during the process of starting up the fuel cell powerplant, so that when hydrogen is available from the hydrogen generator **10**, and the hydrogen input valve **12** may be opened, the coolant will have already established a nominal operating temperature whereby steady-state operation may be achieved much more quickly in the fuel cell **18**. The use of the startup heater **60** provides rapid establishment of steady state operating conditions without the need for a special heater or the consumption of any additional fuel. (Col. 4, ll. 8-18).

*Discussion of the § 103(a) Issue*

“Section 103 forbids issuance of a patent when ‘the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.’ ” *KSR Int’l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1734 (2007).

Appellants have grouped the claims subject to each of the three grounds of rejection separately. However, Appellants rely on the same arguments for each rejection. Accordingly, we confine our discussion to appealed claim 36 pursuant to 37 C.F.R. § 41.37(c)(1)(vii) (2006).<sup>4</sup>

We are unpersuaded by Appellants' argument that one of ordinary skill in the art would have no reason to incorporate Keating's start-up heater in the PEM fuel cells disclosed in Edlund. First, as discussed above, Edlund is not limited to PEM fuel cells, but includes any fuel cell system in which hydrogen gas is produced. (FF 6). Thus, Keating's start-up heater would be useful in any of the fuel cell embodiments of Edlund that would benefit from heating. Second, there is no evidence on the record to support Appellants' assertions that PEM fuel cells would not benefit from being heated during start-up. Appellants must rely on more than attorney argument to support their position. *In re Schulze*, 346 F.2d 600, 602, (CCPA 1965).

We agree with the Examiner that Keating teaches reasons why one of ordinary skill in the art would have applied the start-up heaters in the fuel cell systems of Edlund where appropriate. Specifically, Keating teaches that the use of heaters during the process of starting up the fuel cell system is advantageous to rapidly establish steady state operating conditions without the need of a special heater or the consumption of additional fuel. (FF 8). Thus, as found by the Examiner, Keating teaches improvements in fuel cell

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<sup>4</sup> Only those arguments actually made by Appellants have been considered. Arguments which Appellant could have made but chose not to make have not been considered and are deemed to be waived. *See* 37 C.F.R. § 41.37 (c)(1) (vii) (2004).



performance and cost savings by incorporating start-up heaters into fuel cell systems. (Ans. 13).

Appellants' additional contention that the Examiner is incorrect that Edlund's fuel cell would experience an improvement in overall performance is also not persuasive. This argument appears to be based on Appellants' assertion that the fuel cells disclosed in Edlund do not require heating on start-up. As discussed above, Appellants have provided no evidence to support their contention sufficient to rebut the Examiner's findings. Therefore, Appellants' argument is not persuasive.

Regarding claims 32 and 41, Appellants have presented no separate arguments with respect to these claims. Thus, the discussion with respect to claims 27 and 36 applies to these claims as well.

## CONCLUSION

In light of the above discussion, Appellants failed to demonstrate that the Examiner erred in rejecting claims 27-31 and 34 under 35 U.S.C. § 102(e) as being anticipated by Edlund and claims 36-38, 40, and 43 under 35 U.S.C. § 103(a) as being unpatentable over Edlund in view of Keating. Further, Appellants failed to demonstrate that the Examiner erred in rejecting claim 32 under 35 U.S.C. 103(a) as being unpatentable over Edlund as applied to claim 27, and further in view of LaPierre and claim 41 under 35 U.S.C. 103(a) as being unpatentable over Edlund in view of Keating as applied to claim 36, and further in view of LaPierre.

ORDER

The Examiner's decision rejecting claims 27-32, 34, 36-38, 40, 41, and 43 is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR §1.136(a)(1)(iv).

AFFIRMED

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